CHECK VALVE WITH PRESSURE RELIEF FEATURE

by

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FIELD OF THE INVENTION

This invention relates generally to check valves and, more specifically, to lightweight check valves.

BACKGROUND OF THE INVENTION

Check valves are very common piping fittings which are used to prevent back flow within a run of pipe. A check valve has a body with a hinged flapper disposed inside. The body and the flapper are adapted so that, when back flow occurs within the body, the flapper seals against a valve seat within the body, thereby closing the valve.

A lightweight type of check valve frequently used in plastic pipe runs is a check valve having a gasket sandwiched between a flapper base and a flapper cover. The flapper base has a flapper base stem which extends through a central aperture in the gasket and through a central aperture in the gasket cover. The composite, consisting of flapper base, gasket and flapper cover, is typically held together by the cooperation of the flapper base stem with the flapper cover. Typically, such cooperation takes the form of press-fit or snap-on fit, although adhesives and welding are also sometimes used to connect the flapper base stem and the flapper cover.

A problem exists with such check valves when pressurized liquid on the downstream side of the flapper seeps between the flapper base and the gasket when the flapper is in the closed position. Such seepage leads to pressure build-up across the face of the gasket surface which exerts a significant force against the flapper cover. Such force is frequently sufficient to break the connection between the flapper base stem and the flapper cover, causing the flapper to come apart.

Accordingly, there is a need for a check valve which avoids the aforementioned problem in the prior art in an inexpensive and efficient manner.

SUMMARY

The invention satisfies this need. The invention is a check valve comprising a valve body and a flapper. The valve body defines an internal valve seat. The flapper is hingedly retained within the valve body and is sized and dimensioned to mate with the valve seat. The flapper is adapted to alternatively swing between (i) a closed position wherein the flapper is in sealing contact with the valve seat, and (ii) an open position wherein the flapper is

spaced apart from the valve seat. The flapper comprises (a) a flapper base having a forward surface, a rearward surface and a flapper base stem extending away from the forward surface; (b) a gasket having a first surface, a second surface and a central aperture, the first surface of the gasket being disposed in abutment with the flapper base, with the flapper base stem disposed through the central aperture in the gasket; and (c) a flapper cover having a forward surface, a rearward surface and a central aperture, the forward surface of the flapper cover being disposed in abutment with the second surface of the gasket with the flapper base stem disposed through the central aperture in the flapper cover. In the invention, a central recess is defined in either the forward surface of the flapper base or in the forward surface of the flapper cover, the central recess being sufficient in depth and area to allow liquid disposed between the flapper base and the gasket when the flapper is in the first flapper position to migrate to the flapper base stem.

DRAWINGS

These and other features, aspects and advantages of the present invention will become better understood with reference to the following description, appended claims and accompanying drawings where:

Figure 1 is a cutaway perspective view of a check valve having features of the invention;

Figure 2 is an exploded side view of a flapper mechanism useable in the check valve illustrated in Figure 1;

Figure 3 is a cross-sectional side view of the flapper illustrated in Figure 2, the flapper being shown fully assembled;

Figure 4 is a perspective exploded view of the flapper base and flapper cover illustrated in Figure 3;

Figure 5 is another side view of the flapper illustrated in Figure 3 showing how liquid can seep between the gasket and the flapper face; and

Figure 6 is an enlarged cross-sectional view of the flapper assembly illustrated in Figure 5 showing how features of the invention tend to prevent overpressuring of the flapper assembly.

DETAILED DESCRIPTION

The following discussion describes in detail one embodiment of the invention and several variations of that embodiment. This discussion should not be construed, however, as limiting the invention to those particular embodiments. Practitioners skilled in the art will recognize numerous other embodiments as well.

The invention is a unique check valve **10** comprising a valve body **12** and a flapper **14**. The check valve **10** of the invention is illustrated in Figure 1.

The valve body **12** has side walls **16**, an inlet opening **18** and an outlet opening **20**. Defined within the valve body **12** is a valve seat **22**.

The flapper **14** is hingedly retained within the valve body **12**. The flapper **14** is sized and dimensioned to mate with the valve seat **22**, so as to seal closed the valve seat **22**. The flapper **14** is adapted to alternatively swing between (i) a closed position wherein the flapper **14** is in sealing contact with the valve seat **22**, and (ii) an open position wherein the flapper **14** is spaced apart from the valve seat **22**.

The flapper **14** comprises a flapper base **24**, a gasket **26** and a flapper cover **28**.

The flapper base **24** has a forward surface **30**, a rearward surface **32** and a flapper base stem **34** extending away from the forward surface **30**. When the flapper **14** is in the closed position, the rearward surface **32** of the flapper **14** faces the outlet opening **20**. Typically, the flapper base **24** is made from a plastic material, such as PVC, for ease of manufacture and for resistence to corrosive materials.

The gasket **26** has a first surface **36**, a second surface **38** and a central aperture **40**. The first surface **36** of the gasket **26** is disposed in abutment with the forward surface **30** of the flapper base **24**. The gasket **26** is disposed in conjunction with the flapper base **24** such that the flapper base stem **34** protrudes through the central aperture **40** in the gasket **26**. Typically, the gasket **26** is made from a resilient material such as EPDM or other rubber, and has a uniform thickness of between about 0.03 inch and about 0.375 inch.

Also typically, the flapper **14** is retained within the valve body **12** by an extension of the gasket **26** which is attached to the valve body **12** proximate to the side wall **16** of the valve body **12**. In such embodiments, the gasket **26** provides the hinge mechanism which allows the flapper **14** to alternatively swing between the open position and the closed position.

In the embodiment illustrated in the drawings, the forward surface **32** of the flapper base **24** also defines a plurality of spaced apart locating pegs **42** adapted to align with matching peripheral apertures **44** in the gasket **26** to correctly seat the gasket **26** in abutment with the forward surface **30** of the flapper base **24**.

The flapper cover **28** has a forward surface **46**, a rearward surface **48** and a central aperture **50**. The forward surface **46** of the flapper cover **28** is disposed in abutment with the second surface **38** of the gasket **26**. The central aperture **50** of the flapper cover **28** is sized and dimensioned to receive the flapper base stem **34** therethrough. Typically, the flapper cover **28** is made from a plastic material, such as PVC, for ease of manufacture and for resistance to corrosive materials.

The flapper base stem **34** is attached to the central aperture **50** in the flapper cover **28**, typically by press-fit or snap-fit. In some embodiments, the flapper base stem **34** is attached to the flapper cover central aperture **50** with localized areas of a suitable adhesive or by welding, sonic heat spin techniques, etc. In the embodiment illustrated in the drawings, the snap-fit is provided by adapting the flapper base stem **34** with a rounded circumferential band **51** having a slightly increased diameter over the nominal diameter of the remainder of the stem **34**. The rounded band **51** is sized and dimensioned to snap through the central aperture **50** in the flapper cover **28** upon the exertion of pressure directed against the rearward surface **32** of the flapper base **24** while holding securely the rearward surface **48** of the flapper cover **28**.

A central recess **52** is defined in either the forward surface **30** of the flapper base **24** or in the forward surface **46** of the flapper cover **28**. The central recess **52** is sufficient in depth and area to allow liquid **54** which becomes disposed between the flapper base **24** and the gasket **26** when the flapper **14** is in the closed position to migrate to the flapper base stem **34**. Once such liquid **54** has migrated to the flapper base stem **34**, the liquid **54** can

migrate up the flapper base stem **34**, through the gasket **26**, through the central aperture **50** in the flapper cover **28** to the rearward surface **48** of the flapper cover **28**. By providing such a central recess **52**, the invention endows the check valve of the invention **10** with important pressure relief characteristics.

In the embodiment illustrated in the drawings, the central recess **52** has an outer border **56** provided by a radial ridge **58** which is defined in the forward surface **46** of the flapper cover **28**. The radial ridge **58** typically has a generally uniform height above the forward surface **46** of the flapper cover **28** of between about 0.005 inch and about 0.1 inch. Also, the radial ridge **58** typically has a generally uniform width of between about 0.05 and about 0.5 inch.

In the embodiment illustrated in the drawings, the central recess **52** is further provided by grooves **60** in the forward surface **46** of the flapper cover **28**. Such grooves **60** are disposed between a plurality of spaced apart nodes **62** which are located proximate to the central aperture **50** in the forward surface **46** of the flapper cover **28**. In the embodiment illustrated in the drawings, the forward surface **46** of the flapper cover **28** defines 6 nodes **62**. Typically, the forward surface **46** of the flapper cover **28** defines between about 3 and about 20 nodes **62**, most typically between about 5 and about 7 nodes **62**. The nodes **62** are generally disposed above the forward surface **46** of the flapper cover **28** by a distance of between about 0.005 inch and about 0.1 inch. The nodes **62** have bases **64**, each of which is spaced apart from an adjoining base **64** by a distance of between about 0.03 inch and about 0.3 inch.

As illustrated in Figures 5 and 6, the providing of the central recess **52** in either the forward surface **30** of the flapper base **24** or in the forward surface **46** of the flapper cover **28** allows the unique check valve of the invention **10** to bleed off potentially damaging pressures which can build up between the flapper base **24** and the gasket **26**. This is

accomplished by providing the central recess **52** which allows room for the gasket **26** to be pushed sufficiently aside to provide passage ways for liquid **54** between the forward surface **30** of the flapper base **24** and the gasket **26** to migrate to the flapper base stem **34** and then, subsequently, to migrate up the flapper base stem **34** to the low pressure side at the rearward surface **48** of the flapper cover **28**. Thus, it can be seen that the central recess feature **52** in the check valve of the invention **10** provides that check valve **10** with important pressure relief characteristics which avoids the periodic failures associated with prior art designs.

Having thus described the invention, it should be apparent that numerous structural modifications and adaptations may be resorted to without departing from the scope and fair meaning of the instant invention as set forth hereinabove and as described hereinbelow by the claims.